BEDLOAD TRAP MEASUREMENTS AS PART OF AN INTEGRATIVE MEASUREMENT SYSTEM

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INTRODUCTION

Data of bedload transport form the fundamentals of planning in the fields of river engineering, flood protection, torrent control and waterway management. Furthermore, bedload information is needed for issues concerning ecology and hydropower. In addition, bedload transport measurements are essential to select, apply and calibrate bedload transport formulas and numerical models.
Bedload traps enable continuous and automatic bedload transport measurements. Thereby, the method is applicable for all water stages, especially during floods, when other sampling methods are not operable anymore. Besides, it facilitates the determination of the complete grain size spectrum.
At the mountain torrent Urslau a fixed bedload trap forms an indispensable part of the 2010 installed integrative bedload measurement system, including a geophone device and mobile basket samplers.
This paper is focused on the applied bedload trap and aims to discuss the possibilities of this measurement method in combination with direct and surrogate measurement methods.

STUDY SITE

The mountain torrent Urslau with a drainage basin of about 121 km² is located in the alpine region of Austria and discharges into the Saalach River. The main stream Urslau is an intensively bed load transporting torrent with numerous debris flow tributaries. The study site (displayed in figure 1) is located in the upper catchment near the city Maria Alm with a drainage basin of 56 km^2. The mean discharge is 4.39 ms^{-1} and average slope is about 10 %. The bed-width is 8.2 m.

Fig. 1 Study Site Urslau in Austria / Salzburg

METHODS

The bedload trap contains a sample box (1.8m x 0.7m x 0.9m) which is placed on four load cells. The lid covering the sample container has a longitudinal slot of 1.6 x 0.5 meters. Two side doors at the container enable the documentation of bedload stratification. The dimensions of the bedload trap are

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illustrated in figure 2. The trap is mounted in the middle of the cross-section. In rest position the slot is closed and flush with the river bed. To start bedload sampling the slot is opened hydraulically via manual control, enabling bedload material to be trapped into the container. The load cells commence recording automatically the mass increase within the trap. To be able to analyse the trapped material a crane withdraws the filled container and places it on to the riverbank. The empty trap has to be reinserted into the riverbed for further measurements.

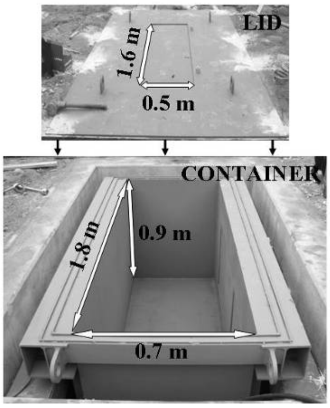

Fig. 2 Dimensions of the bedload trap, installed at the mountain torrent Urslau

POSSIBILITIES OF BEDLOAD TRAP MEASUREMENTS

In situ and laboratory measurements have revealed that the trap has a high hydraulic efficiency. Habersack et al., 2001 have shown for a bedload trap applied in the Drau River that hydraulic efficiency is almost one until a filling stage of 80 percent of the trap volume.
The relatively high capacity of 1.13m³ enables sufficiently long sampling periods in order to determine bedload transport in the course of a flood wave. Thereby, a precise process description is possible, due to the continuous recording of mass increase in combination with analysis of the material stratification. Hence, temporal variability in bedload transport and bedload material can be obtained. Moreover, this bedload measurement method enables to gather the occurring bedload texture. Measurements can be undertaken at the whole hydrograph, providing bedload transport data at high water stages.

DISCUSSION

Measurements with the applied bedload trap achieve accurate and reliable results. Due to its fixed position in the cross-section, the bedload transport measurement is spatially restricted. The sampling durations depend on the intensity of bedload transport and is limited by reservoir capacity of the trap.
To obtain continuous bedload data at high discharges and to achieve information about the spatial and temporal variability of the process the bedload trap is complemented by additional measurement instruments like geophones and mobile basket samplers. Direct bedload measurements undertaken by slot traps and mobile basket samplers are also used to calibrate bedload data derived by surrogate measurement techniques such as geophones and hydrophones.

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